REMARKS

Regarding the Status of the Claims:

Claims 23 – 34, 38 – 50, 52 – 54 and 56 – 57 are pending.

Claims 1 – 22, 35 – 37, 51 and 55 are cancelled.

No claims have been withdrawn from consideration.

Regarding the Claim Rejections:

The Office action rejects:

I. claims 23 – 24, 26 – 30, 32 – 34, 38 – 50, 52 – 54, and 56 – 57 under 35 U.S.C §103(a) over US 5,593,516 to Cassada III (hereinafter, "Cassada");

II. claim 25 under 35 U.S.C §103(a) over Cassada and US 6,562,154 to Rioja et al. (hereinafter, "Rioja"); and

III. claim 31 under 35 U.S.C §103(a) over Cassada and "Metals Handbook Desk Edition, pp. 445 – 446 (hereinafter, "MHDE").

Regarding Rejection I:

Applicants respectfully submit the rejection of claims 23 – 24, 26 – 30, 32 – 34, 38 – 50, 52 – 54 and 56 – 57 under 35 U.S.C §103(a) over Cassada should be withdrawn.

i. Cassada teaches away from the present invention

The arguments in this section were discussed during the interview and it was agreed that Cassada taught that its equations relating Mg and Cu were mandatory.

On page 4, lines 6 – 7 of the Office action inappropriately, and inaccurately distills two columns of Cassada to a teaching that "the control of the copper and magnesium would be in order to avoid excess solute that would contribute to the second phase content and diminish fracture toughness (cols. 3 – 4)" and that such control occurs in only one of many possible embodiments of Cassada's invention.

The Office action's reliance on the words, "In one aspect of the invention" (col. 3, lines 51-54) is misplaced in view of Cassada's overwhelming disclosure that this one aspect is required.

The Office action's distillation of columns 3 and 4 of Cassada is inappropriate,

because "[a] prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention." MPEP §2141.02.VI, citing *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

Moreover, the Office action's distillation of columns 3 and 4 of Cassada is inaccurate, because Cassada makes clear that the total amount of magnesium and copper must be controlled such that the solid solubility limit of the alloy is not exceeded.

In the abstract, Cassada states according to the present invention, "[t]he amounts of copper and magnesium are controlled such that the solid solubility limit for these elements in aluminum is not exceeded."

In column 2, lines 38 – 42, Cassada states, "[a] further object of the present invention is to provide an aluminum based alloy having copper and magnesium amounts below the solubility limit to obtain acceptable levels of strength while providing higher damage tolerance or improved toughness."

In column 2, lines 38 – 42, Cassada states, "[t]he relationship between the amounts of copper and magnesium are such that the solubility limit is not exceeded."

In column 3, lines 18 – 26, Cassada states, "[t]he present invention is directed to an improved aluminum-copper-magnesium alloy .... The aluminum-based alloy ... consists essentially of 2.5 – 5.5 percent by weight copper, 0.10 – 2.3 percent by weight magnesium, and the balance aluminum, and wherein the total amount of magnesium and copper is such that the solid solubility limit of the alloy is not exceeded."

In column 3, lines 58 – 62, Cassada states, "[i]t has been discovered that combinations of both high strength and high toughness are obtained in the alloy of the present invention by controlling the range of composition of the solute elements of copper and magnesium such that the solid solubility limit is not exceeded."

In column 4, lines 5 – 7, Cassada states, "[i]t is important to avoid any excess solute that would contribute to the second phase content of the material and diminish its fracture toughness."

In column 4, lines 7 – 9, Cassada states, "[i]n theory, the maximum solute level, copper plus magnesium, should be held to this solubility limit." Cassada goes on to express the maximum theoretical limit by equation (1) $Cu_{max} = -0.91(Mg) + 5.59$. No

embodiment of Cassada can fall outside the maximum theoretical limit.

Additionally, in column 4, lines 19 – 20, Cassada states, "[i]n practice, the solute levels must be controlled to just below the solubility limit to avoid second phase particles." In column 4, lines 25 – 27, Cassada stresses, "[i]f the bulk copper level is close to the solubility limit, these regions will exceed the solubility limit and contain insoluble second phase particles." Cassada expresses the maximum practical limit by equation (1) $Cu_{preferred} = -0.91(Mg) + 5.2$.

In column 4, lines 62 – 65, Cassada explains, "[t]he preferred range for copper is 2.50 to 5.50 weight percent and the preferred range for magnesium is 0.10 to 2.30 weight perecent." Next, in column 4, line 65 – column 5, line 1, Cassada stresses, "[a]dditionally, within these ranges, the amounts of copper and magnesium must be interrelated to ensure that the solid solubility limit for any specific composition is not exceeded." In column 5, lines 1 – 5, Cassada explains the reason for this mandatory interrelationship between copper and magnesium by stating, "[w]hen the amounts of copper and magnesium are too high, there is an unacceptable reduction in fracture toughness properties. When the amounts of copper and magnesium are too low, the strength of the alloy is too low." (emphasis added).

In column 6, lines 53 – 59, Cassada explains, "[a]ccording to this invention, it has been discovered that the amounts of copper and magnesium, as well as the relationship between the amounts, are critical and essential to provide an aluminum-based alloy which has excellent combinations of mechanical strength and fracture toughness."

In column 6, lines 59 – 62, Cassada states, "[a]ccording to the present invention, maintaining the combination of copper and magnesium amounts in the alloy below the solid solubility limit provides a combination of both high strength and high fracture toughness."

Claim 1 recites the equations:

(1) $Cu_{max} = -0.91(Mg) + 5.59$

(2) $Cu_{min} = -0.91(Mg) + 4.59$

When properly considered as a whole, Cassada makes clear that the total amount of magnesium and copper must be controlled such that the solid solubility limit of the alloy is not exceeded.

ii. Response to the Examiners' request for a further explanation as to why the present invention does not overlap Cassada

During the interview the undersigned asserted Claim 23 recites 4.3 – 4.9 % Cu and 1.5 – 1.8 % Mg. Applying the mandatory solubility equations for the Mg levels of claim 23 results in the following Cu levels:

(1) Cu_{max} = -0.91(Mg) + 5.59= -0.91 (1.5) + 5.59 = 4.22%; and

(2) Cu_{min} = -0.91(Mg) + 4.59= -0.91 (1.8) + 4.59 = 2.95%.

In other words, for the Claim 23 Mg range of 1.5 - 1.8%, Cassada dictates a Cu range of 2.95 – 4.22%. In contrast, Claim 23 recites 4.3 – 4.9 % Cu.

During the interview the Examiners presented a calculation of max and min Cu values using the Mg endpoints of Cassada Claim 1.

(1) Cu_{max} = -0.91(Mg) + 5.59= -0.91 (0.1) + 5.59 = 5.5%; and

(2) Cu_{min} = -0.91(Mg) + 4.59= -0.91 (2.3) + 4.59 = 2.5%.

The Examiners asserted using the Mg endpoints from the present application Claim 23, rather than the Mg endpoints from Cassada, artificially limited the Cu range. Moreover, the Examiners asserted if the Cassada Claim 1 Mg values were used then the resulting 2.5-5.5% Cu range would overlap the range of present Claim 23. Applicant explains as follows why there is no overlap.

The Cu max and Cu min values change for each value of Mg. This is the purpose of defining Cu max and Cu min with equations rather than simple values. Thus, the equations apply point by point so a Cu value appropriate for a first Mg value could be inappropriate for another Mg value.

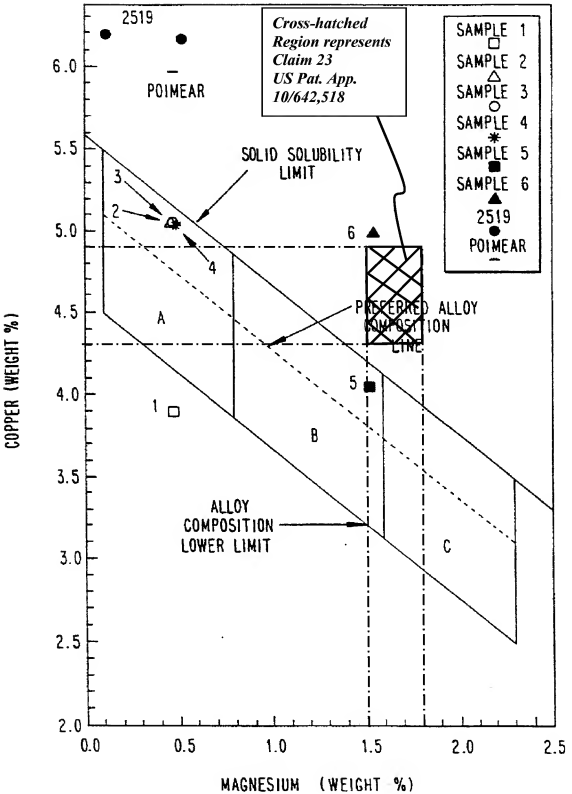
For example, at the 0.10% Mg lower endpoint of Cassada Claim 1, the Cu max is 5.5% and the Cu min is 4.5%.

At the 2.30% Mg upper endpoint of Cassada Claim 1, the Cu max is 3.5% and the Cu min is 2.5%.

Thus, the overall calculation by the Examiners at the interview used the Cu max for one value of Mg and the Cu min for another value of Mg to arrive at the 2.5 to 5.5% Cu range. However, this did not take into account that the max and min have to change when the Mg changes. For example, none of the Cu values appropriate at the Mg lower endpoint are permitted at the Mg upper endpoint.

Likewise, for the present Claim 23 range of 1.5 - 1.8% Mg the equations of Cassada do not permit the Claim 23 range of 4.3 – 4.9 % Cu. Cassada dictates a range of 2.95 – 4.22% Cu and even these Cu values are not all appropriate for every value in the range of 1.5 - 1.8% Mg.

This is shown by the following plot which adds the region defined by the Mg and Cu ranges of Claim 23 to Cassada Fig. 1 which graphically shows the region of Mg and Cu combinations defined by the Cassada equations. The region of Claim 23 does not overlap the region permitted by Cassada. Thus, the levels of Mg and Cu of claim 23 do not overlap the mandatory interrelationships of Mg and Cu levels taught by Cassada.


2519
POIMEAR
Cross-hatched Region represents Claim 23 US Pat. App. 10/642,518
SAMPLE 1
SAMPLE 2
SAMPLE 3
SAMPLE 4
SAMPLE 5
SAMPLE 6
2519
POIMEAR
SOLID SOLUBILITY LIMIT
PREFERRED ALLOY COMPOSITION LINE
ALLOY COMPOSITION LOWER LIMIT
A
B
C
1
2
3
4
5
6
COPPER (WEIGHT %)
MAGNESIUM (WEIGHT %)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
0.0
0.5
1.0
1.5
2.0
2.5

iii. The lack of overlap combined with the teaching away is sufficient to establish non-obviousness

In addition to there being no overlap, Applicants assert the ranges are not sufficiently close to establish a *prima facie* case of obviousness. As quoted above, Cassada repeatedly and emphatically teaches away from the Cu and Mg levels of Claim 23. Contrary to the assertion in the Office action, no apparent reason exists for a skilled artisan to ignore those teachings. It goes against conventional wisdom as taught by the reference. MPEP §2145.X.D.3, citing *In re Hedges*, 783 F.2d 1038, 228 USPQ 685 (Fed. Cir. 1986)(Applicant's claimed process for sulfonating diphenylsulfone at a temperature above 127°C was contrary to accepted wisdom because prior art as a whole suggested using lower temperatures for optimum results as evidenced by charring, decomposition, or reduced yields at higher temperatures.).

As mentioned above, in column 4, line 65 – column 5, line 1, Cassada stresses, "[a]dditionally, within these ranges, the amounts of copper and magnesium must be interrelated to ensure that the solid solubility limit for any specific composition is not exceeded." In column 5, lines 1 – 5, Cassada explains the reason for this mandatory interrelationship between copper and magnesium by stating, "[w]hen the amounts of copper and magnesium are too high, there is an unacceptable reduction in fracture toughness properties. When the amounts of copper and magnesium are too low, the strength of the alloy is too low." (emphasis added).

Moreover, if the proposed modification of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the reference is not sufficient to render the claims *prima facie* obvious. MPEP §2143.01.VI. Cassada requires controlling the amount of Cu permitted for a given amount of Mg. The present invention operates outside these controlled amounts. Thus, one would have to change the principle of operation of Cassada to modify Cassada's alloy to arrive at the present alloy.

Thus, Applicants submit a *prima facie* case of obviousness has not been established and withdrawal of this rejection is respectfully requested.

iv. Dependent Claims further distinguish over Cassada

The following table shows present dependent claims have Cu ranges spaced as much or further from those permitted by Cassada's Cu_{max} and Cu_{min} equations.

Present Claim	Mg	Cu	Cu permitted by Cassada's Cu_{max} and Cu_{min} equations for this Mg range
Claim 38	1.5 - 1.8%	4.3 - 4.6%	2.95 - 4.22%
Claim 39	1.5 - 1.8%	4.4 - 4.5%	2.95 - 4.22%
Claim 40	1.5 - 1.7%	4.4 - 4.9%	3.04 - 4.22%
Claim 41	1.5 - 1.7%	4.3 - 4.9%	3.04 - 4.22%
Claim 54	1.68-1.8%	4.3 - 4.9%	2.95 - 4.06%
Claims 56 and 57	1.6 - 1.7%	4.3 - 4.5%	3.04 - 4.04%

v. Alloy 1 shows the benefit of no Mn with high Si commensurate with Claim 56

On page 6, lines 13 – 15, Office action states "Applicant has not shown the criticality of the ranges with respect to the acquired toughness, strength or any other properties recited in the claims …."

As explained above, Applicants submit a *prima facie* case of obviousness has not been established and a showing of unexpected results is not necessary. However, applicants also submit they have shown unexpected results commensurate at least with Claim 56.

MPEP §716.02(d) (citing *In re Hill*, 284 F.2d 955, 128 USPQ 197 (CCPA 1960)) explains, "[t]o establish unexpected results over a claimed range, applicants should compare a sufficient number of tests both inside and outside the claimed range to show the criticality of the claimed range." It is submitted the below-described comparison achieves this.

The comparison (an indirect comparison as explained below) is to the closest prior art. MPEP §716.02(e). Applicant does not have to create prior art for a comparison. MPEP §716.02(e).III. Thus, in the case of the selection invention of Claim 56, applicants need only compare to the closest example of the closest reference. It is submitted Cassada Alloy Sample 6 is the closest example of Cassada to Claim 56 (Declaration of

Alfred Heinz, Jan. 14, 2007, paragraph 15). It is noted Cassada states Alloy Sample 6 is outside its inventive alloy (Cassada, col. 8, lines 1-3; see also Declaration of Alfred Heinz, Jan. 14, 2007, paragraph 15).

Moreover, as explained below, Alloy 2 is closer to Claim 56 than the closest exemplified alloy of Cassada. Proof of unexpected properties may be in the form of direct or indirect testing of the claimed invention and the prior art. *In re Boesch*, 205 USPQ 215 (CCPA 1980). Thus, patentability can be established by proof of improved results for the claimed invention in comparison with prior art even more closely related than the prior art relied upon by the Examiner. MPEP §716.02(e).I; *Ex parte Hunter*, 217 USPQ 265 (Bd. App. 1981). Thus, as explained below, the showing of unexpected advantages of Alloy 1 over Alloy 2 is sufficient to show unexpected advantages of Alloy 1 over the closest alloy of Cassada.

The following Table A compares AA2024, AA2525, Alloy 1 and Alloy 2 of Tables 1-3, Cassada Alloy Sample 6, and present Claim 56. Claim 56 recites an alloy having 4.3 to 4.5% Cu, 0 % Mn, 1.6 to 1.7%Mg, 0.23 to 0.30 % Si, and 0.06-0.10% Fe. Alloy 1 has no Mn and a high Si level and is within Claim 56. Alloy 2 has no Mn and a relatively lower Si level outside Claim 56.

Table A - Chemical composition, in weight %,

Alloy	AA2024 *	AA2524 *	1*	2*	Cassada Alloy Sample 6**	Present Claim 56***
Cu	4.4	4.3	4.4	4.4	4.91	4.3 - 4.5
Mn	0.59	0.51	0	0	-	0
Mg	1.51	1.39	1.68	1.61	1.61	1.6-1.7
Zr	0	0	0	0	0.11	-
Si	0.05	0.05	0.25	0.11	0.02	0.23-0.30
Fe	about 0.06	about 0.06	about 0.06	about 0.06	0.01	0.06-0.10
Ag	-	-	-	-	0.50	-
Cr	-	-	-	-	-	≤ 0.15

* balance aluminum and inevitable impurities

** V 0%, balance aluminum and inevitable impurities

*** balance essentially aluminum and incidental elements and impurities, which are at most 0.05% per element, 0.15% total

As mentioned above, Alloy 1 is within Claim 56 and Alloy 2 is outside Claim 56. However, the following Table B shows Alloy 2 is closer than Cassada Alloy Sample 6 to present Claim 56 (see also Declaration of Alfred Heinz, Jan. 14, 2007, paragraph 19).

Applicants assert this Declaration of Dr. Alfred Heinz is entitled to be given weight because an Examiner may not under 35 USC §103 substitute his own speculation for the factual knowledge of those skilled in the art. An affidavit of an expert in the field can shift the burden of proof to the Examiner to come forth with further proof for his conclusion of obviousness. *In re Katzschmann*, 146 USPQ 66 (CCPA 1965). See also, MPEP §716.01(c).III.

Table B - Chemical composition, in weight %

Alloy	2*	Cassada Sample 6**	Present Claim 56***	Comments on closeness to Claim 56 ranges
Cu	4.4	4.91	4.3 - 4.5	Alloy 2 has Cu 0.1% below the upper end of the claimed range. Cassada Sample 6 has Cu 0.41% above the claimed range.
Mn	0	-	0	Alloy 2 and Cassada Sample 6 lack Mn.
Mg	1.61	1.61	1.6-1.7	Alloy 2 and Cassada Sample 6 are within the claimed range.
Zr	0	0.11	-	Alloy 2 is closer.
Si	0.11	0.02	0.23-0.30	Alloy 2 is closer.
Fe	about 0.06	0.01	0.06-0.10	Alloy 2 is closer.
Ag	-	0.50	-	Alloy 2 is closer.
Cr	-	-	$\leq$ 0.15	Alloy 2 and Cassada alloy Sample 6 both lack Cr.

* balance aluminum and inevitable impurities

** V 0%, balance aluminum and inevitable impurities

*** balance essentially aluminum and incidental elements and impurities, which are at most 0.05% per element, 0.15% total

Thus, it is submitted a comparison of Alloys 1 and 2 is a better comparison to prove unexpected results of Alloy 1 than a comparison of Alloy 1 and Cassada Alloy Sample 6.

Comparison of the PS and FCGR properties of Alloys 1 and 2 of Table 1 establishes the criticality of the Claim 56 alloy having 0.23 to 0.30 % Si with 0% Mn as discussed below.

Table 2 of the present application shows Alloy 1 has expectedly higher tensile yield strength (PS) than Alloy 2.

Table 3 shows Alloys 1 and 2 have a significant unexpected improvement in toughness, as measured by fatigue crack growth rate, over the "baseline" AA2024 alloy which has 4.4 % Cu, 1.51 % Mg and 0.05% Si. Thus, Alloy 1 achieves the advantageous higher tensile yield strength (PS) shown in Table 2 while also having toughness significantly higher than baseline as shown in Table 3. Thus, Alloy 1 obtains a beneficial combination of properties.

Page 11 of the present application explains the following:

> "From the results of Table 3 it is clear that the lifetime is the better the lower the level of manganese is. By adding silicon the strength levels (as shown in Table 2) increase again while the improvement in lifetime is still considerably high. That means that the improvement in fatigue crack growth rate is significantly higher when manganese levels are low, more or less independent of the level of silicon. That means that those alloys, especially at lower ΔK-values, have a significant longer lifetime and therefore are very useful for aeronautical applications."

For the Examiner's convenience Tables 2 and 3 of the present application are reproduced below.

Table 2: Tensile properties and notch toughness of alloys 1 to 4 of Table 1 in the L and T-L direction.

	L		T-L
Alloy	**PS (MPa)**	**UTS (MPa)**	**TS/Rp**
AA2024	344	465	1.74
AA2524	338	447	1.99
1	325	451	1.97
2	310	458	2.09

Table 3: Fatigue crack growth rate for all alloys compared with commercially available AA2024 alloy (=baseline).

Alloy	**Cycles between a=5 and 20mm**	**Improvement in lifetime over AA2024**
AA2024	170,694	baseline
AA2524	216,598	27%
1	283,876	66%
2	322,940	89%

It is submitted a comparison of the overall benefits of Alloy 1, with its unexpectedly better PS over Alloy 2 while maintaining a significant improvement in toughness over AA2024 and AA2524, is sufficient to show unexpected advantages of Alloy 1 over Alloy 2.

Applicant notes Alloy 1 has higher Mg and higher Si than Alloy 2 and page 7 of the present application says, "Magnesium also provides strength to the alloy product." However, the difference in Mg is only 0.07% from a base of 1.61% and is too small to be the driving force to the higher tensile yield strength (PS) of Alloy 1 shown in Table 2 as stated in the Declaration of Dr. Alfred Heinz, Jan. 14, 2008, para. 21. In contrast, the 0.25% Si of Alloy 1 is more than double the 0.11% Si of Alloy 2. Thus, Alloy 1 has unexpectedly better tensile yield strength than Alloy 2 as shown in Table 2 due to the increased level of Si in Alloy 1 (Declaration of Dr. Alfred Heinz, Jan. 14, 2008, para. 21).

As explained above, Applicants assert this Declaration of Dr. Alfred Heinz is entitled to be given weight because an Examiner may not under 35 USC §103 substitute his own speculation for the factual knowledge of those skilled in the art.

Furthermore as seen in the above Table A, Claim 56 encompasses Alloy 1 within such a small range that it would be reasonably expected that the unexpected results occur over the entire range. Although objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support, the probative value of a narrow range of data can be reasonably extended to prove the unobviousness of a broader claimed range when one could ascertain a trend in the exemplified data which would allow him to reasonably extend the probative values thereof. *In re Clemens*, 206 USPQ 289 (CCPA 1980).

Thus, this showing of unexpected advantages for Alloy 1 over Alloy 2 is sufficient to prove unexpected results over Cassada for Claim 56.

Regarding Rejection II:

Applicants respectfully submit the rejection of claim 25 under 35 U.S.C §103(a) over Cassada and Rioja should be withdrawn.

It is respectfully submitted the teaching of Rioja et al. relied upon in the Office action does not make up for the above-described deficiencies of Cassada.

Regarding Rejection III:

Applicants respectfully submit the rejection of claim 31 under 35 U.S.C §103(a) over Cassada and MHDE should be withdrawn.

It is respectfully submitted the teaching of MHDE does not make up for the above described deficiencies of Cassada.

In Conclusion:

The present application is in condition for allowance. Applicants request favorable action in this matter. To facilitate the resolution of any issues or questions presented by this paper, the Examiner is welcome to contact the undersigned by phone to further the discussion.

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